Oct. 26, 1948. W. M. LEEDS 2,452,477

CIRCUIT INTERRUPTER

Filed April 16, 1945 2 Sheets-Sheet 1

Fig. 1.

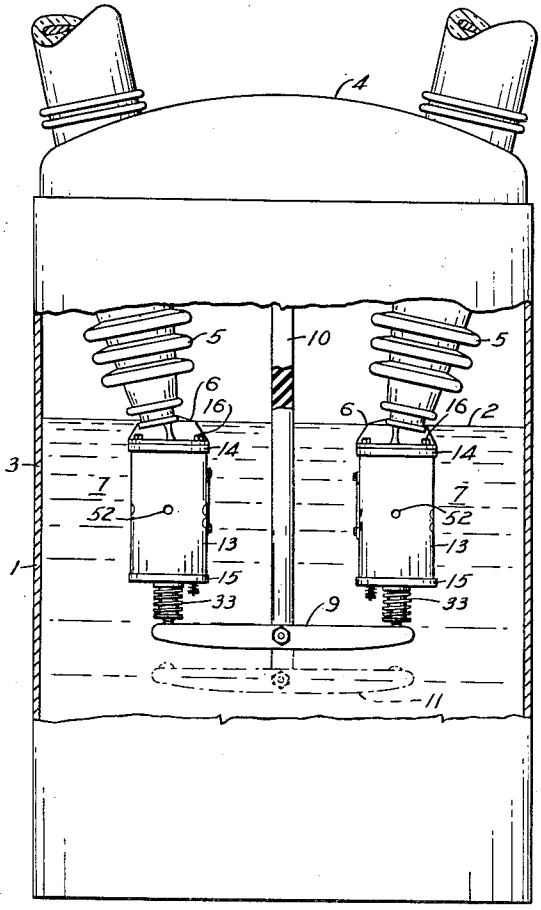


Fig. 2.

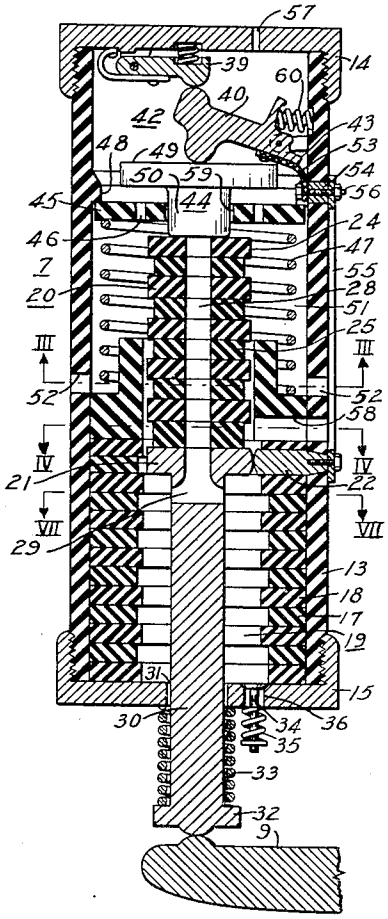


Fig. 3.

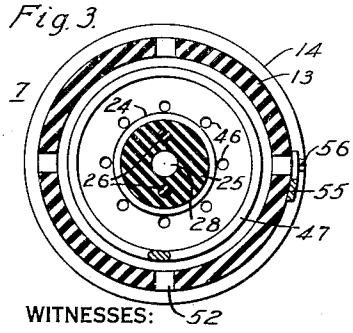
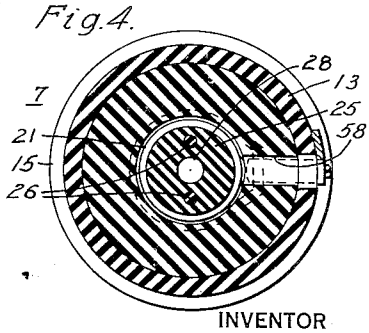


Fig. 4.



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CIRCUIT INTERRUPTER

Filed April 16, 1945 2 Sheets-Sheet 2

Fig. 5.

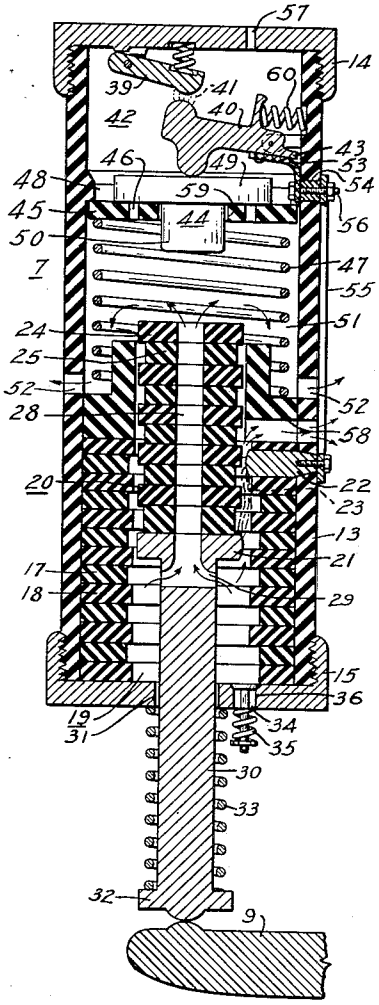


Fig. 6.

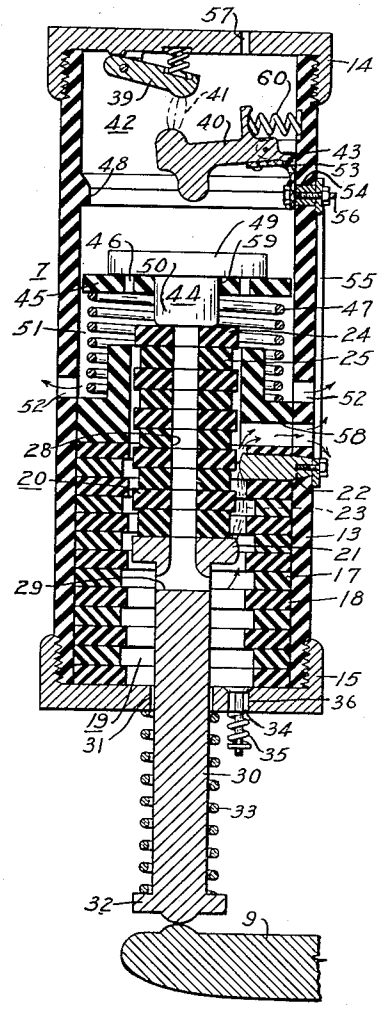
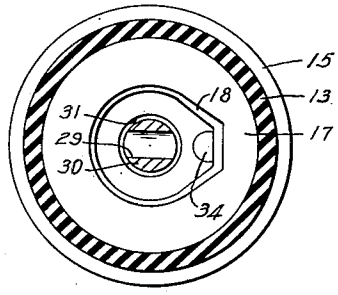


Fig. 7.



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2,452,477

UNITED STATES PATENT OFFICE

2,452,477

CIRCUIT INTERRUPTER

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Application April 16, 1945, Serial No. 588,573

17 Claims. (Cl. 200—150)

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This invention relates to circuit interrupters in general and, more particularly, to improved arc extinguishing structures therefor.

In United States Patent No. 2,253,009, which issued August 19, 1941, to Benjamin P. Baker and which was assigned to the assignee of the instant application, there is disclosed an arc extinguishing structure having a piston member carrying the movable contact and being movable into a piston chamber to cause thereby a displacement of the fluid within the piston chamber upwardly longitudinally of the arc to effect its extinction. The stationary contact was disposed adjacent the open end of the piston chamber and a vent was provided adjacent the stationary contact to permit fluid having contacted the arc to escape out of the arc extinguishing structure through the vent. In the operation of the aforesaid arc extinguishing structure considerable force, provided in the form of accelerating compression springs, was required to force the piston member carrying the movable contact into the piston chamber during the opening operation. This vertical flow type of oil circuit interrupter has been shown to have a definite current interrupting limitation for a given driving force and oil flow velocity. Mechanical load limitations of the circuit breaker closing device make undesirable the use of additional accelerating force, in the form of additional accelerating springs, to obtain increased oil velocity. The greater the accelerating compression spring load employed, the greater the force is imposed on the closing mechanism to charge the accelerating springs during the closing operation.

In a patent application filed April 6, 1945, Serial No. 586,909, now U. S. Patent 2,420,889, issued May 20, 1947, to Winthrop M. Leeds and assigned to the assignee of the instant application, there is disclosed and claimed an arc extinguishing structure in which additional driving force during high current interruption is obtained by the use of a serially related pressure-generating arc. My present invention is concerned with improvements on the structure disclosed in the aforesaid application.

A general object of my invention is to provide an improved arc extinguishing device which will rapidly effect the extinction of the arc formed therein.

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A more specific object is to provide an improved circuit interrupter in which a piston member moves within a piston chamber and causes thereby a displacement of fluid which is directed toward the established arc. I provide a by-passing channel formed in the piston member to permit part of the fluid disposed within the piston chamber to by-pass the arc during low current interruption so as to permit an adequate speed of piston and contact movement. Preferably I employ a series pressure-generating arc to obtain booster action when interrupting high currents, closing the by-pass channel to increase the volume of oil directed toward the arc, and providing the necessary additional driving force for moving the piston member into the piston chamber to thereby obtain greater effectiveness in extinguishing the arc during high-current interruption.

Further objects and advantages will readily become apparent upon a reading of the following specification taken in conjunction with the drawings in which:

Figure 1 is an elevational view partly in section of a complete circuit interrupter embodying my invention and shown in the closed circuit position;

Fig. 2 is an enlarged vertical sectional view of the left-hand arc extinguishing unit shown in Fig. 1, the parts being shown in the closed circuit position;

Fig. 3 is an inverted view taken on the line III—III of Fig. 2;

Fig. 4 is a view in section taken on the line IV—IV of Fig. 2;

Fig. 5 is a view similar to Fig. 2 but showing the disposition of the parts at an intermediate point during the opening operation when interrupting a low value of current;

Fig. 6 is a view similar to Fig. 5 but showing the disposition of the parts at an intermediate point during the opening operation when interrupting a high value of current; and

Fig. 7 is a view in section taken on the line VII—VII of Fig. 2.

Referring to the drawings and, in particular, to Fig. 1, the reference numeral 1 designates a tank filled to the level 2 with a suitable arc extinguishing fluid 3, in this instance oil. Depending from the cover 4 of the tank 1 are a pair of

insulating bushings 5 which enclose terminal studs not shown. Threaded to the lower ends of the terminal studs and clamped thereto are a pair of contact feet 6 which support a pair of arc extinguishing units, generally designated by the reference numeral 7.

The arc extinguishing units 7 are electrically bridged in the closed circuit position, as shown by the full lines in Fig. 1, by a conducting bridging bar 9 which is actuated reciprocally in a vertical direction by an insulating operating rod 10. The operating rod 10 may be actuated by suitable operating mechanism, not shown. The dotted lines 11 in Fig. 1 indicate the full open circuit position of the interrupter.

Referring more particularly to Fig. 2, which is a vertical sectional view through the left-hand arc extinguishing unit 7 of Fig. 1, there is provided an insulating casing 13 of generally cylindrical shape. At the first or upper end of the casing 13 is threadedly secured a metallic cover plate 14. The cover plate 14 may be secured in position to the contact foot 6 by any suitable means such as the bolts 16 (see Fig. 1). Threadedly secured to the second or lower end of the insulating casing 13 is a metallic end plate 15. Disposed within the casing 13 and resting on the end plate 15 are a plurality of insulating plates 17, 18 having a configuration more clearly shown in Fig. 7. The plates 17, 18 form a piston chamber, generally designated by the reference numeral 19. Operative into and out of the piston chamber 19 is a first piston member, generally designated by the reference numeral 20. The first piston member 20 carries a movable interrupting contact 21 which cooperates with a stationary interrupting contact 22 to draw an interrupting arc 23 as shown in Figs. 5 and 6.

A plurality of insulating washer-shaped members 24, 25 are secured to and movable with the movable interrupting contact 21 by means of two insulating tie rods 26 as more clearly shown in Figs. 3 and 4. It will be noted that the insulating washers 24, 25 of different outer diameters enclose a central by-pass channel 28 which extends through the first piston member 20. A laterally extending passage 29 is formed in the conducting shank 30 of the piston member 20. Consequently, the by-pass channel 28 communicates through the laterally extending passage 29 to the piston chamber 19 below the piston member 20.

An aperture 31 is formed in the end plate 15 and serves to guide the conducting shank 30. At the lower end of the shank 30 there is formed an offstanding flange 32, which serves as a lower seat for a first biasing means or accelerating compression spring 33, which biases the piston member 20 into the piston chamber 19. A valve 34 controls an aperture 36 formed in the end plate 15, the purpose for which will appear more clearly hereinafter. The valve 34 is biased toward its seating position as shown in Fig. 2 by a compression spring 35.

Disposed within the casing 13, at the first or upper end thereof, is a resiliently mounted stationary pressure-generating contact 39 which cooperates with a movable pressure-generating contact 40 to establish a pressure-generating arc 41 as more clearly shown in Figs. 5 and 6. The pressure-generating arc 41 is formed within a pressure-generating chamber, generally designated by the reference numeral 42. The movable pressure-generating contact 40 has integrally formed therewith a stop portion 43 which serves to limit the maximum length of the pressure-generating arc 41.

The lower wall of the pressure generating chamber 42 is formed by a composite second piston member, generally designated by the reference numeral 44. The second piston member 44 in this instance comprises two parts. The first part is a ring-shaped insulating piston plate 45 having apertures 46 formed therein. A second biasing means comprising a compression spring 47 biases the ring-shaped piston plate 45 toward its upper position where it abuts against an inwardly extending flange 48 integrally formed with the casing 13. The second part of the piston member 44 is a piston valve member 49 which is slidably mounted in a centrally formed aperture 59 formed in the ring-shaped piston plate 45. The lower portion 50 of the piston valve member 49 abuts against the first piston member 20 in the closed circuit position of the interrupter as shown in Fig. 2 to close the by-pass channel 28.

Below the second piston member 44 is an exhaust chamber, generally designated by the reference numeral 51, in which there is a relatively low pressure maintained by the provision of a plurality of vents 52 formed in the casing 13 as more clearly shown in Fig. 3. A flexible conductor 53 electrically connects the movable pressure generating contact 40 to a metallic collar 54, the right-hand end of which is electrically connected to a conducting strap 55 by a nut and bolt connection 56. The conducting strap 55 extends longitudinally externally of the casing 13 and is connected at its lower end to the stationary interrupting contact 22.

A bleeder opening 57 is provided for the pressure generating chamber 42 to permit the accumulated gas to pass out following a circuit opening operation. A vent 58 is disposed above the stationary interrupting contact 22 and serves as an exhaust for the discharge of fluid which has contacted the arc 23.

The operation of the interrupter will now be explained. In the closed circuit position of the interrupter, as shown in Figs. 1 and 2, the electrical circuit therethrough comprises left-hand terminal stud (not shown), contact foot 6, metallic cover plate 14, stationary pressure generating contact 39, movable pressure generating contact 40, flexible conductor 53, metallic collar 54, conducting strap 55, stationary interrupting contact 22, movable interrupting contact 21, conducting shank 30, bridging bar 9 through the right-hand arc extinguishing unit 7 in an identical manner to the right-hand terminal stud.

When it is desired to open the electrical circuit passing through the interrupter, or in response to overload conditions existing in the circuit controlled by the interrupter, suitable operating mechanism, not shown, is actuated to cause downward movement of the operating rod 10. The downward movement of the operating rod 10 permits the first biasing means or the accelerating compression spring 33 to force the first piston member 20 downwardly into the piston chamber 19. The downward movement of the piston member 20 permits the piston valve member 49 to move downwardly, the compression spring 47 meanwhile maintaining the ring-shaped piston plate 45 in its upper position abutting against the flange 48. The downward movement of the piston valve member 49 permits the compression spring 60 to force the movable pressure generating contact 40 downwardly away from the sta-

tionary pressure generating contact 39 to draw a pressure generating arc 41 within the pressure generating chamber 42.

During the interruption of low currents, the pressure formed by the pressure generating arc 41 within the pressure generating chamber 42 will be low. This low pressure formed within the pressure generating chamber 42 during the interruption of low currents will not be sufficient to force the piston member 44 downwardly against the upward force exerted by the compression spring 47. Consequently, as shown in Fig. 5, the piston member 44 will not follow the first piston member 20 but will remain in its upper position as shown in Fig. 5. This permits the by-pass channel 28 to be uncovered and some of the oil disposed below the first piston member 20 may pass upwardly through the by-pass channel 28 into the exhaust chamber 51 and out the vents 52. Also oil below the first piston member 20 is forced upwardly longitudinally of the interrupting arc 23 and out the vent 58 as indicated by the arrows in Fig. 5.

It will consequently be apparent that during the interruption of low currents when considerable oil flow is not required to effect extinction of the interrupting arc 23, that the by-pass channel 28 will be opened during this time to permit relatively rapid downward movement of the first piston member 20 and the movable contact 21 into the piston chamber 19. During this downward movement of the piston member 20 into the piston chamber 19 the interrupting arc 23 is interrupted by a moderate vertical flow of oil displaced by the moving contact 21. The design is such that extinction of the low current arc takes place approximately at the position of the parts shown in Fig. 5, so that further downward movement of the piston member 20 into the piston chamber 19 causes a flushing flow of oil upwardly between the contacts 21, 22 and out the vent 58 to sweep decomposed and carbonized products of decomposition out of the casing 13 through the vent 58. The downward movement of the piston member 20 continues until the movable contact 21 strikes the end plate 15, at which time the bridging bar 9 separates from the shank 30 to introduce two isolating gaps into the circuit following arc extinction as shown by the dotted lines 11 in Fig. 1.

During the closing operation the bridging bar 9 moves upwardly to pick up the shank 30 and to draw fresh oil into the piston chamber 19 through the valve 35. Consequently, the valve 35 permits a unidirectional flow of fresh oil into the piston chamber 19 during the closing stroke, and during the opening stroke the valve 35 remains closed so that the fresh oil may be displaced upwardly toward the interrupting arc 23. During the final portion of the closing stroke, the piston member 20 engages the lower portion 50 of the piston valve member 49 to raise the latter and force the movable pressure generating contact 40 into contact with the stationary pressure generating contact 39. This raises the piston valve member 49 away from the apertures 46 provided in the ring-shaped piston plate 45 to prevent pressure forming within the pressure generating chamber 42 during the final portion of the closing stroke. In other words, an arc may jump between the contacts 39, 40 when they near engagement and this arc would produce pressure to tend to impede the closing operation. Since the piston valve member 49 during this final portion of the closing stroke uncovers the apertures 46, this pressure

may be immediately relieved through the apertures 46 and into the exhaust chamber 51.

Referring to Fig. 6, which shows the disposition of the parts during the interruption of high current, it will be observed that the pressure now formed at the pressure generating arc 41 will be considerable due to the greater amount of current passing through the arc 41. This high pressure formed within the pressure generating chamber 42, during the interruption of high current arcs, will force the piston valve member 49 downwardly to close the apertures 46 and the entire second piston member 44 will move downwardly against the biasing action exerted by the compression spring 47 and will also maintain the upper end of the by-pass channel 28 closed as shown in Fig. 6. Consequently, the high pressure now formed within the pressure generating chamber 42 will serve to do two things. First, it will drive the piston valve member 49 downwardly to assist the compression spring 33 in moving the first piston member 20 into the piston chamber 19. Thus during the interruption of high currents when a greater amount of oil at a greater velocity is needed to interrupt the interrupting arc 23, the piston member 44 will help the spring 33 to drive the first piston member 20 downwardly into the piston chamber 19 at a relatively high speed to obtain a displacement of oil to flow at considerable velocity upwardly longitudinally of the interrupting arc 23 to effect the extinction thereof.

Secondly, it will be observed that the piston member 44 maintains the by-pass channel 28 closed so that all of the displaced oil is utilized in the vertical flow for assisting deionization of the interrupting arc 23. The operation is such that the high current interrupting arc 23 is extinguished when the parts are in the position as shown in Fig. 6, so that further downward movement of the piston member 20 into the piston chamber 19 again causes a flushing flow of oil upwardly between the contacts 21, 22 and out of the casing 13 through the vent 58. It will, of course, be apparent that following the extinction of the interrupting arc 23, the pressure generating arc 41 will simultaneously be extinguished and the compression spring 47 will cause the second piston member 44 to rise to its upward position, the pressure within the pressure generating chamber 42 lowering due to the ejection of gas out of the bleeder opening 57. The closing operation is the same as previously described in connection with low current interruption.

It will be observed that by the provision of the insulating plates 17, 18 that the inner surface of the piston chamber 19 is irregular. Also the washer-shaped members 24, 25 of different external diameters form an irregular surface on the piston member 20. These irregular surfaces retain fresh oil adjacent the arc 23 as the arc is drawn downwardly between these irregular surfaces and consequently fresh oil of high dielectric strength is thus retained adjacent the arc 23 to assist in its deionization.

Since the by-pass channel 28 is uncovered during the interruption of low currents as shown in Fig. 5, the speed of downward motion of the movable interrupting contact 21 is considerably increased during the interruption of low currents as a result of the passage of oil upwardly through the by-pass channel 28. I prefer to have the arrangement such that the downward movement of the first piston member 20 causes the arcs 41, 23 to be established practically simultaneously. Thus the pressure immediately

formed in the pressure generating chamber 42 is available at once to assist the downward movement of the first piston member 20.

From the above description it will be apparent that I have provided an improved circuit interrupter in which an arc is established upon movement of a piston member into a piston chamber. The resulting displacement of fluid is caused to flow toward the established arc and I have provided by-passing means for diverting part of the flow of displaced fluid away from the arc during low current interruption. It will furthermore be apparent that I have provided means, in this instance piston means, for controlling the flow of fluid through the by-passing means as a function of the current magnitude being interrupted. During high current interruption the pressure formed by the series arc serves to close the by-passing channel and also to help drive the first piston member into the piston chamber 19 to effect rapid lengthening of the interrupting arc 23 and increased oil velocity adjacent thereto as a result of the increased downward speed of the first piston member 20. During low current interruption, the pressure formed at the series arc is relatively low and the by-pass channel is uncovered to permit rapid downward movement of the first piston member 20 caused solely by the compression spring 33 as a result of part of the displaced fluid within the piston chamber 19 flowing upwardly through the by-pass channel 18.

Although I have shown and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In a circuit interrupter, a piston chamber, a stationary contact, a piston member carrying a movable contact and operative within the piston chamber, the movable contact separating from the stationary contact to establish an arc when the piston member is moved into the piston chamber, the movement of the piston member into the piston chamber causing fluid to flow toward the arc to facilitate the extinction thereof, a by-pass channel formed in the piston member to permit fluid within the piston chamber to by-pass the arc, and means operable only during high current interruption to close the by-pass channel.

2. In a circuit interrupter, a piston chamber, a stationary contact disposed at one side of the piston chamber, a piston member operative within the piston chamber, a movable contact carried on one side of the piston member and separable from the stationary contact to establish an arc upon movement of the piston member into the piston chamber, the movement of the piston member into the piston chamber displacing fluid toward the arc to facilitate the extinction thereof, and a by-pass channel formed in the piston member to permit fluid disposed within the piston chamber to by-pass the arc.

3. In a circuit interrupter, a piston chamber, a piston member movable into the piston chamber to cause the flow of fluid, means for establishing an arc upon movement of the piston member into the piston chamber, the resulting flow of fluid contacting the arc, by-passing means for diverting part of the flow of fluid away from the arc,

and means responsive only to high current operation to render the by-passing means inoperative.

4. In a circuit interrupter, a piston chamber, a stationary contact disposed at one side of the piston chamber, a piston member operative within the piston chamber, a movable contact carried on one side of the piston member and separable from the stationary contact to establish an arc upon movement of the piston member into the piston chamber, the movement of the piston member into the piston chamber displacing fluid toward the arc to facilitate the extinction thereof, a by-pass channel formed in the piston member to permit fluid disposed within the piston chamber to by-pass the arc, and means comprising a series arc to assist the movement of the piston member into the piston chamber.

5. In a circuit interrupter, a piston chamber, a stationary contact disposed adjacent the open end of the piston chamber, a first piston member carrying a movable contact and operative into and out of the piston chamber, movement of the first piston member into the piston chamber drawing an arc between the stationary and movable contacts, a by-pass channel provided in the first piston member to permit fluid disposed within the piston chamber to by-pass the arc, a second piston member for controlling the opening of the by-pass channel, and means comprising a series pressure generating arc for causing the second piston member to both close the by-pass channel and assist driving the first piston member into the piston chamber during high current interruption.

6. In a circuit interrupter, a piston chamber, a stationary contact disposed adjacent the open end of the piston chamber, a first piston member carrying a movable contact and operative into and out of the piston chamber, movement of the first piston member into the piston chamber drawing an arc between the stationary and movable contacts, a by-pass channel provided in the first piston member to permit fluid disposed within the piston chamber to by-pass the arc, a second piston member for controlling the opening of the by-pass channel, means comprising a series pressure generating arc for causing the second piston member to both close the by-pass channel and assist driving the first piston member into the piston chamber during high current interruption, and biasing means biasing the second piston member away from the by-pass channel so that during low current interruption the by-pass channel will be open.

7. In a circuit interrupter, a piston chamber at one side of which is disposed a stationary interrupting contact, a first piston member carrying a movable interrupting contact and operative within the piston chamber, biasing means for biasing the first piston member into the piston chamber to cause a separation of the movable interrupting contact from the stationary interrupting contact for establishing an interrupting arc, a pressure generating chamber in which are disposed a pair of serially related pressure generating contacts, a second piston member serving as one wall of the pressure generating chamber, and the pressure formed within the pressure generating chamber during high current interruption driving the two piston members together to facilitate the lengthening of the interrupting arc.

8. In a liquid break circuit interrupter, a piston chamber having an irregular inner surface for retaining liquid, a stationary contact disposed at the open end of the piston chamber, a piston

member carrying a movable contact and also having an irregular surface for retaining liquid, the piston member being movable into the piston chamber to establish an arc therein, movement of the piston member into the piston chamber displacing liquid longitudinally of the arc, and a by-pass channel provided in the piston member to speed up its movement into the piston chamber.

9. In a liquid break circuit interrupter, a piston chamber having an irregular inner surface for retaining liquid, a stationary contact disposed at the open end of the piston chamber, a piston member carrying a movable contact and also having an irregular surface for retaining liquid, the piston member being movable into the piston chamber to establish an arc therein, movement of the piston member into the piston chamber displacing liquid longitudinally of the arc, a by-pass channel provided in the piston member to speed up its movement into the piston chamber, and biasing means for biasing the piston member into the piston chamber tending to elongate the arc to effect its extinction.

10. In a liquid break circuit interrupter, a piston chamber having an irregular inner surface for retaining liquid, a stationary contact disposed at the open end of the piston chamber, a piston member carrying a movable contact and also having an irregular surface for retaining liquid, the piston member being movable into the piston chamber to establish an arc therein, movement of the piston member into the piston chamber displacing liquid longitudinally of the arc, a by-pass channel provided in the piston member to speed up its movement into the piston chamber, a serially related pressure generating arc, and means utilizing the pressure of the pressure generating arc for driving the piston member into the piston chamber to effect a rapid interrupting arc length during high current interruption.

11. In a circuit interrupter, a piston chamber at one side of which is disposed a stationary interrupting contact, a first piston member carrying a movable interrupting contact and being movable into the piston chamber to draw an interrupting arc between the stationary and movable interrupting contacts and to displace fluid longitudinally of the interrupting arc, a by-pass channel provided through the first piston member, a pressure generating chamber in which are disposed a pair of serially related pressure generating contacts cooperable to establish a pressure generating arc, a second piston member serving as one wall of the pressure generating chamber and closing the by-pass channel when in the closed circuit position, the arrangement operating during high current interruption such that the second piston member closes the by-pass channel and drives the first piston member into the piston chamber to rapidly elongate the interrupting arc.

12. In a circuit interrupter, a piston chamber at one side of which is disposed a stationary interrupting contact, a first piston member carrying a movable interrupting contact and being movable into the piston chamber to draw an interrupting arc between the stationary and movable interrupting contacts and to displace fluid longitudinally of the interrupting arc, a by-pass channel provided through the first piston member, a pressure generating chamber in which are disposed a pair of serially related pressure generating contacts cooperable to establish a pressure generating arc, a second piston member serving as one wall of the pressure generating

chamber and closing the by-pass channel when in the closed circuit position, the arrangement operating during high current interruption such that the second piston member closes the by-pass channel and drives the first piston member into the piston chamber to rapidly elongate the interrupting arc, a valve disposed in the second piston member to prevent excess pressure being formed in the pressure chamber during a closing operation.

13. In a circuit interrupter, a piston chamber at one side of which is disposed a stationary interrupting contact, a first piston member carrying a movable interrupting contact and being movable into the piston chamber to draw an interrupting arc between the stationary and movable interrupting contacts and to displace fluid longitudinally of the interrupting arc, a by-pass channel provided through the first piston member, a pressure generating chamber in which are disposed a pair of serially related pressure generating contacts cooperable to establish a pressure generating arc, a second piston member serving as one wall of the pressure generating chamber and closing the by-pass channel when in the closed circuit position, the arrangement operating during high current interruption such that the second piston member closes the by-pass channel and drives the first piston member into the piston chamber to rapidly elongate the interrupting arc, a first biasing means biasing the first piston member into the piston chamber, and a second biasing means biasing the second piston member away from the first piston member.

14. In a circuit interrupter, an arc extinguishing unit, a pressure generating chamber disposed at a first end of the unit, a pair of pressure generating contacts disposed within the pressure generating chamber cooperable to establish a pressure generating arc, a piston chamber disposed at the second end of the unit, a stationary interrupting contact positioned at the open end of the piston chamber, a first piston member carrying a movable interrupting contact operative within the piston chamber, a portion of the first piston member extending through the second end of the unit, a by-passing channel extending through the first piston member to facilitate rapid lengthening of the interrupting arc during low current interruption, a second piston member serving as one wall of the pressure generating chamber and bearing against the by-passing channel in the closed circuit position of the interrupter, the pressure generated by the pressure generating contacts within the pressure generating chamber driving the second piston member toward the second end of the unit to close the by-passing channel and to force the first piston member into the piston chamber to effect rapid arc lengthening during high current interruption.

15. In a circuit interrupter, a piston chamber, a piston member movable into the piston chamber to cause the flow of fluid, means for establishing an arc upon movement of the piston member into the piston chamber, the resulting flow of fluid contacting the arc, and by-passing means for diverting part of the flow of fluid away from the arc, and means controlling the flow of fluid through the by-passing means as a function of the current magnitude being interrupted.

16. In a circuit interrupter, a piston chamber, a piston member movable into the piston chamber to cause the flow of fluid, means for establishing an arc upon movement of the piston member into the piston chamber, the resulting flow of fluid

contacting the arc, and by-passing means for diverting part of the flow of fluid away from the arc, and piston means controlling the flow of fluid through the by-passing means as a function of the current magnitude being interrupted.

17. In a circuit interrupter, a piston chamber, a piston member movable into the piston chamber to cause the flow of fluid, means for establishing an arc upon movement of the piston member into the piston chamber, the resulting flow of fluid contacting the arc, and by-passing means for diverting part of the flow of fluid away from the arc, piston means for controlling the flow of fluid

through the by-passing means, a series arc, the pressure from the series arc acting on one side of the piston means.

WINTHROP M. LEEDS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,111,416	Balachowsky	Mar. 15, 1938